

WHAT WE CLAIM IS:

- 1 1. A process for transmitting digital data to an A/D converter via an analog
2 channel, comprising:
3 generating a sequence of output signals by precoding a sequence of input signal
4 points to precompensate for ISI in the analog channel, at least one of the output signals
5 would be distorted by the ISI to a signal representative of a signal point lying between
6 quantization levels of the A/D converter if the precoding matches the ISI, others of the
7 output signals would be distorted by the ISI to signals representative of signal points that
8 are quantization levels of the A/D converter if the precoding matches the ISI, a majority
9 of the input signal points are quantization levels of the A/D converter.
- 1 2. The process of claim 1, wherein the quantization levels are the
2 quantization levels of a PCM vocoder.
- 1 3. The process of claim 2, wherein the precoding further comprises:
2 precompensating an input signal point for the ISI; and
3 adding a modulo amount to the precompensated signal point in response to
4 precompensated signal point having a value outside of a threshold range.
- 1 4. The process of claim 3, wherein the adding includes determining the value
2 of the modulo amount in a manner responsive to the value of the input signal point that
3 was precompensated.
- 1 5. The process of claim 4, wherein the threshold range is dependent on the
2 value of the input signal point that was precompensated.
- 1 6. The process of claim 4, wherein the threshold range is independent of the
2 value of the input signal point that was precompensated.
- 1 7. The process of claim 1, wherein another of the output signals would be
2 distorted by the ISI to a signal representative of a signal point lying between quantization

3 levels of the A/D converter, first and second ones of the output signals lying between
4 different pairs of quantization levels.

1 8. The process of claim 1, wherein each of the input signal points is
2 representative of a value of a quantization level of the D/C converter.

1 9. A transmitter for transmitting digital data to an A/D converter via an
2 analog channel, the transmitter comprising:

3 a precoder being configured to precompensate a sequence of input signal points
4 for ISI in the analog channel and being characterized by an original constellation and an
5 extended constellation, a majority of the signal points of the original constellation being
6 quantization levels of the A/D converter, and the extended constellation including at least
7 one signal point that is not a quantization level of the A/D converter.

1 10. The transmitter of claim 9, wherein the quantization levels characterizing
2 a portion of the points in the constellations are quantization levels of a PCM vocoder.

1 11. The transmitter of claim 10, further comprising:

2 a trellis encoder to produce the input signal points by encoding digital data, the
3 trellis encoder is coupled to transmit the input signal points to the precoder.

1 12. The transmitter of claim 11, wherein the trellis encoder is configured to
2 produce signal points representative of the quantization levels of the PCM vocoder.

1 13. The transmitter of claim 10, wherein the precoder trellis encodes the input
2 signal points and further produces signals representative of signal points of the original
3 constellation in response to being configured to precompensate for zero ISI in the analog
4 channel.

1 14. The transmitter of claim 10, wherein the precoder comprises:

2 a digital filter to generate feedback signal points from precompensated signal
3 points produced from the input signal points by the precoder;
4 an adder to combine the feedback and associated input signal points; and
5 a modulo device to produce a signal point within a threshold range from a signal
6 point received from the adder.

1 15. The transmitter of claim 14, wherein the modulo device is configured to
2 add a modulo amount to a signal point received from the adder in response to the
3 received signal point not having a value in the threshold range.

1 16. The transmitter of claim 14, wherein the threshold range is dependent on
2 the value of the input signal point that was precompensated.

1 17. The transmitter of claim 14, wherein the threshold range is independent of
2 the value of the input signal point that was precompensated.

1 18. The transmitter of claim 15, wherein the modulo device is configured to
2 determine the threshold range from the value of the associated input signal point.

1 19. The transmitter of claim 9, wherein the extended constellation includes a
2 plurality of signal point values that are not equal to quantization levels of the A/D
3 converter.

1 20. A process for communicating data over an analog channel in both
2 downstream and upstream directions, comprising:

3 monitoring a quantity representative of an echo level caused by downstream data
4 transmission;

5 resetting a power level for downstream transmissions over the analog channel to a
6 lower value in response to determining that the echo level interferes with upstream data
7 transmissions over the analog channel.

1 21. The process of claim 20, further comprising:
2 channel encoding data prior to transmitting the data downstream; and
3 decoding upstream transmitted data to recover the data.

1 22. The process of claim 20, further comprising:
2 resetting includes selecting a constellation for the downstream data transmission
3 that produces a lower average power level on the analog channel.

1 23. The process of claim 20, wherein the echo level changes the amount of
2 quantization noise in upstream transmitted data.

1 24. A transceiver for transmitting and receiving digital data via a mixed
2 channel that includes a digital network and an analog channel serially connected to the
3 digital network, comprising:

4 a transmitter capable of error-encoding digital data and of transmitting encoded
5 data downstream to a target transceiver via the mixed channel; and
6 a receiver capable of error-decoding received digital data transmitted upstream
7 from the target transceiver via the mixed channel, the transmitter configured to reduce
8 downstream transmission power in response to determining that echo from downstream
9 transmissions interferes with upstream transmissions from the target transceiver.

1 25. The transceiver of claim 24, wherein the transmitter is configured to lower
2 the downstream transmission power in response to determining that the power level
3 causes an above-threshold noise level in upstream transmissions from the target receiver.

1 26. The transceiver of claim 24, wherein the transmitter is configured to set
2 the power level in part by selecting a signal constellation for transmitting data
3 downstream.

1 27. The transceiver of claim 24, wherein the transmitter includes a
2 probabilistic trellis encoder to perform the encoding.

1 28. The transceiver of claim 24, wherein the receiver includes a Viterbi
2 decoder and is configured to scale 1D branch metrics used in the decoder in a manner
3 responsive to reliability information derived from the received digital data.

1 29. A receiver capable of receiving signals from a mixed channel that includes
2 a digital network and an analog channel serially connected to the digital network, the
3 receiver comprising:

4 a Viterbi decoder configured to process the received signals in a manner
5 responsive to reliability information derived from the signals, the reliability information
6 being indicative of potential magnitudes of quantization noise in the received signals.

1 30. The receiver of claim 29, further comprising:

2 an adder configured to subtract an estimate of an echo level from each received
3 signal and to transmit the echo-subtracted signal to the Viterbi decoder; and
4 a device configured to derive the reliability information from the received signals;
5 and

6 wherein the adder and device are coupled to obtain the received signals in
7 parallel.

1 31. The receiver of claim 29, wherein the received signals are representative
2 of signal points belonging to constellations, and the reliability information corresponding
3 to ones of the received signals is a function of minimum distances of the constellations
4 associated with the ones of the received signals.

1 32. The receiver of claim 29, wherein the Viterbi decoder is configured to
2 scale 1D branch metrics that are used in decoding in a manner that is responsive to the
3 reliability information.